


2015

Northwest Fisheries Science Center


YEAR IN REVIEW



151 papers published



2 fish stocks rebuilt based on center science



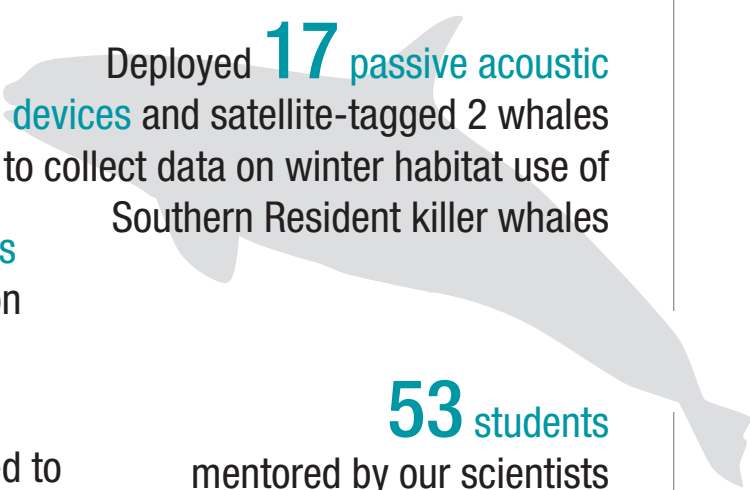
132 days at sea aboard the NOAA ship *Bell M. Shimada*

Collected over **500** samples of massive west coast harmful algal bloom to identify hotspots and assess geographic extent


Analyzed **20,000** genetic samples of marine life to answer pressing conservation and enforcement queries



Completed detailed status reviews of **155** salmon populations



Deployed **17** passive acoustic devices and satellite-tagged 2 whales to collect data on winter habitat use of Southern Resident killer whales



170 scientific papers reviewed to produce comprehensive literature review on climate change and salmon

Partnered with over **40** organizations to understand why many young salmon die when they enter the Salish Sea

1 detailed facility analysis completed to replace our laboratory at Mukilteo

53 students mentored by our scientists



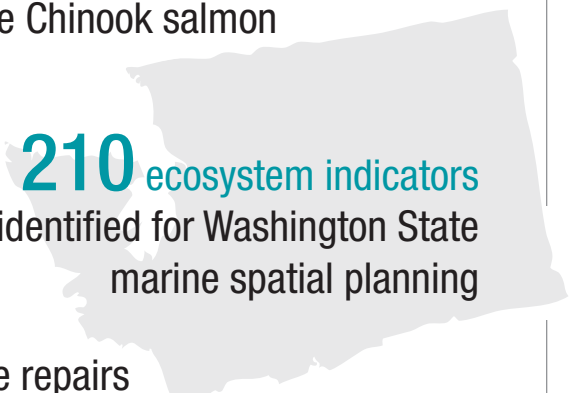
Rescued **51** endangered adult sockeye salmon from dangerously warm waters to safeguard the population

Monitored effects of restoring **750** acres of Skagit River estuary on listed juvenile Chinook salmon

Key partner in restoring **350** acres of historic wetlands in the Snohomish River estuary and conducting the monitoring to assess effectiveness



1 patent awarded for a microparticulate feeder for larval marine fish



210 ecosystem indicators identified for Washington State marine spatial planning

Over **\$1.5M** secured for infrastructure repairs

HIGHLIGHTED ACCOMPLISHMENTS FROM 2015

SUSTAINABLE FISHERIES

Two stocks - Canary rockfish and petrale sole - rebuilt based on NWFSC assessments

Canary rockfish stocks have been managed under a rebuilding plan since 2000. This rebuilding plan strictly limits the amount of canary rockfish caught as bycatch in other fisheries, and therefore has severely constrained the catch of several other fisheries. This year's stock assessment indicated that the stock had completed the process of rebuilding, with spawning output well above the target. This rebuilding success will allow fishermen greater freedom to maximize sustainable harvests of other healthy species. Petrale sole is one of the most valuable groundfish species on the west coast. The 2009 stock assessment showed it to be overfished and it was subsequently placed on a rebuilding plan. The 2015 update assessment indicated that petrale sole had also exceeded its rebuilding target, allowing for increased harvests under sustainable management.

Improved stock assessment precision using geospatial software and new statistical methods

Key components of all stock assessments are indices of abundance, distribution and density of the assessed species – the more precise and accurate, the better. Researchers developed statistical methods and a publicly available geo-spatial software tool to estimate and visualize species densities for all surveyed fishes in the California Current. We used this approach to improve the precision of indices of abundance for groundfish stock assessments in 2015; it is also being used to estimate changes in species distribution as potentially caused by climate change. The tool is also being expanded for use in other NMFS regions (the Eastern Bering Sea, the Gulf of Alaska, and the Northwest Atlantic) and internationally (New Zealand mid-water trawl fisheries).

Provided support for enforcement of conservation laws

We led an interagency forensics working group for combatting IUU fishing and seafood fraud that developed procedures for the use and development of forensic tools, access of partner agency resources, and development of specific forensic analysis information required by each agency to promote effective enforcement actions.

Documented reduction in risk-taking behavior under new catch shares program

Commercial fishing is a dangerous occupation despite decades of regulatory initiatives aimed at making it safer. Previous research suggested catch share management may improve safety by reducing the competitive "race to fish," which often results in risky behavior such as fishing in poor weather or overloading vessels. We employed a novel approach to evaluate the safety benefits of catch shares: estimating the change in the propensity to start a fishing trip in poor weather conditions as a result of the management change, using data from the West Coast Sablefish Fixed Gear fishery. This work indicates a substantial reduction in risk-taking behavior by fishermen (an 85 percent decrease in the annual average rate of fishing on high wind days) that is due to the change in economic incentives provided by catch shares.

HIGHLIGHTED ACCOMPLISHMENTS FROM 2015 (cont.)

HABITAT CONSERVATION

Monitored response of listed juvenile Chinook salmon to restoration of 750 acres of Skagit River estuary

Estuaries are widely regarded as important nursery environments for juvenile life stages of commercially and culturally important species, but few studies have been able to document the benefits of estuary restoration to populations. The 20-year Skagit River Intensively Monitored Watershed Project (IMW) is a partnership between NOAA Fisheries, tribes, and the state and examines the benefits of multiple estuary restoration projects on federally listed Chinook salmon in the largest estuary in Puget Sound. Partners have restored over 750 acres of estuary in the Skagit River and NWFS findings show positive changes for nursery habitat function, such as longer residencies of juvenile salmon in the estuary. These studies are also shedding light on declining populations of forage fish like surf smelt and Pacific herring, which are important prey for Chinook salmon.

Identified 210 indicators for Washington State marine spatial planning

We completed a project for Washington State to identify, screen and develop ecosystem indicators for marine habitats on Washington State's outer coast. The focal habitats included the pelagic zone, the seafloor, kelp forests, rocky shores, sandy beaches, and coastal estuaries. The team produced a series of conceptual models that graphically depict the key processes and components of each of these habitat types, and produced a list of indicators related to physical and oceanographic processes, ecological interactions, and important human activities.

PROTECTED RESOURCES

Analyzed 20,000 genetic samples of marine life

We collected and analyzed genetic data from nearly 20,000 fish, marine mammals, corals, and other marine organisms to address critical questions in fishery management and conservation. We used the resulting genetic information to gain insights into stock structure of salmon and rockfish, examine the reproductive success of individual hatchery and wild salmon, estimate the diets of endangered Southern Resident killer whales, and identify species for law enforcement.

Completed detailed status reviews of 155 salmon populations

Working with state and tribal co-managers, we compiled updated data on the abundance, productivity, distribution and diversity for 155 populations within the 17 listed Distinct Population Segments of five salmon species in the Pacific Northwest. The resulting report documents the current status of these listed species, and is being used by the NOAA Fisheries West Coast Regional Office to report on listing status of these species in early 2016.

Deployed 17 passive acoustic monitoring devices and satellite-tagged 2 whales to collect data on winter distribution of Southern Resident killer whales

We helped increase knowledge of the endangered Southern Resident killer whales' coastal distribution by the successful satellite-linked tagging of two whales, which, in coordination with a winter survey, allowed for collection of critical winter diet samples. Information on winter distribution was also improved by the successful deployment of 17 passive acoustic monitoring devices in a project funded by the U.S. Navy.

Improved understanding of underwater noise and impacts on Southern Residents

We published a novel study quantifying the metabolic costs of sound production in dolphins, which will inform models of how environmental noise impacts killer whales and other marine mammals. We published a second study analyzing the sound levels received by the whales, and how these sounds are correlated with vessel numbers and vessel behavior. This important study is the first step in evaluating the effectiveness of the vessel approach regulations and enforcement implemented in the last two years.

Published literature review of over 170 scientific papers on effects of climate change on salmon

Climate change is anticipated to have adverse effects on a variety of aquatic species. For Pacific salmon, in particular, the effects are especially pervasive as these fish traverse a diversity of freshwater and marine ecosystems during their lifetimes. Scientists from the NWFS conducted a detailed literature review of over 170 scientific papers to highlight new developments in the literature. This review consolidates a huge amount of information, provides stakeholders with a strong overview of what literature is available, and directs interested individuals to databases to get the information they need on a range of climate-related topics.

Continued partnering with over 40 organizations on Salish Sea Marine Survival Project

The marine survival for many stocks of Pacific salmon that migrate through the inland sea is now a fraction of what it was 30 years ago. These declines complicate efforts to recover federally threatened stocks because poor marine survival is widely regarded as a system-wide constraint on productivity outside the scope of local recovery efforts. The Salish Sea Marine Survival Project (2014-2018) seeks to understand the drivers of these trends by bringing together multidisciplinary expertise from over 40 federal and state agencies, tribes, academia and nonprofit organizations on both sides of the US-Canada border. The project will help managers better understand the vital relationship between salmon and their marine waters.

Rescued 51 endangered adult sockeye salmon from dangerously warm waters to safeguard the population

Adult sockeye returning to the Columbia River basin in 2015 had to endure extremely warm water temperatures. Estimates of mortality for endangered Snake River sockeye over the 700 km journey to the Lower Granite Dam (the final dam) ranged as high as 90%. In an effort to ensure the entire 2015 sockeye return was not lost, regional salmon managers asked NOAA Fisheries staff to collect endangered Snake River adult sockeye so the Idaho Department of Fish and Game sockeye program could transport them to their recovery hatchery. This four week effort resulted in 51 adult sockeye collected and delivered to the spawning grounds for the sockeye recovery program. Additionally, Center scientists released 323 adult Redfish Lake sockeye from our captive broodstock program into the lakes to supplement the population.

AQUACULTURE

Determined the dietary taurine requirement for sablefish, a cold water marine fish species with high potential for domestic aquaculture

Established dietary taurine requirements for optimum growth and feed efficiency for juvenile sablefish receiving plant based feeds. Results from this study are expected to increase the performance of alternative, plant based feeds formulated for cold water marine fish and enable regulatory agencies to better estimate potential human exposure to taurine from the consumption of fish receiving these feeds.

One patent awarded for a microparticulate feeder for larval marine fish

Microparticulate diets for larval and small juvenile fish pose specific challenges for aquaculturists. We invented a feeder for larval and juvenile fishes, capable of delivering a small, precise dose of microparticulate (ca. 100 µm diameter) feed to selected locations, via pneumatic conveyance and control. When not in use, the feeder is sealed, and the feed protected from moisture and ambient oxygen. NOAA received a patent and has made the technology available for licensing by the private sector. We anticipate that the most popular use of our feeder will be as a laboratory tool where small batches of fish are reared for experimental purposes. The feeder could also find use in small production hatcheries, such as exotic fishes for the aquarium trade.

SEAFOOD SAFETY

Collected over 500 samples of massive west coast harmful algal bloom to identify hotspots and assess geographic extent

In 2015, a massive bloom of the marine diatom *Pseudo-nitzschia*, stretching from central California to southern Alaska, resulted in significant impacts to coastal resources and marine life. This bloom caused closure of the razor clam fishery, resulting in an estimated \$9.2 million in lost income and closed the Dungeness commercial crab fishery, worth over \$170 million annually in the three west coast states. NWFS coordinated sampling on NOAA fisheries survey and ocean acidification cruises this summer from California to Alaska to identify hotspots and assess the overall extent of the bloom. Over 500 samples, representing over 100 days at sea, will be analyzed for toxins, toxic cells, chlorophyll and other parameters to describe the environmental controls on the bloom initiation, persistence, and demise.

Published landmark paper describing delayed ecological impacts on Prince William Sound fisheries following 1989 Exxon Valdez Oil Spill

The 1989 *Exxon Valdez* spill extensively oiled shoreline-spawning habitats in Prince William Sound. The commercial herring fishery collapsed 3-4 years later, at a time when herring spawned in or near the spill zone would have recruited into the adult population. Pink salmon populations also declined in impacted regions of the Sound. The study found that exposure to oil in early development affected heart function and swimming performance in later life stages. This study adds to a growing awareness of the importance of sublethal effects in ecotoxicology and fisheries management and provides a plausible explanation for the delayed, population-scale losses of herring and salmon years after the 1989 spill.

Developed models for fish survey data from over 50 species to assess impacts of Deepwater Horizon oil spill

The Deepwater Horizon oil spill has produced a number of negative effects on living marine resources and related economies in the Gulf of Mexico. We applied spatiotemporal models to fish survey data from over 50 species to examine evidence of impacts of the Deepwater Horizon spill, and how those changes compared relative to other natural disasters in the region such as hurricanes. Results from the analysis indicated strong spatial variation in fish density, largely as a result of fluctuations in environmental conditions (temperature, salinity).

